

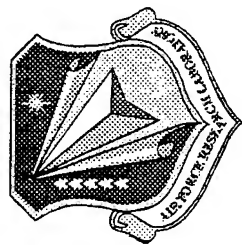
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MEMORANDUM FOR IN-HOUSE PUBLICATIONS

FROM: PROI (TI) (STINFO)

30 Apr 98

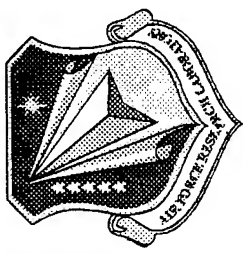
SUBJECT: Authorization for Release of Technical Information, Control Number: AFRL-PR-ED-TP-1998-089
Pat Carrick "New Propellants and Propulsion Techniques" HEDM Presentation (Statement A)



New Propellants and Propulsion Techniques

Dr Patrick Carrick
Air Force Research Laboratory
Propulsion Sciences and
Advanced Concepts Division
Edwards AFB, CA

Outline



High Energy Density Matter (HEDM)

- Energetic liquid hydrocarbon fuels
- Non-toxic liquid monopropellants
- Cryogenic solid propellants
- Theory development & calculations

Laser Propelled Lightcraft

Concepts Examined



Chemically Bound Excited States

High Spin States

Dications

Ionic Hydrogen Clusters

Too reactive or unstable;
no good stabilization method

Unique Inorganic Molecular
Systems

Strained Ring Systems

Small Molecules

High payoff areas
for energetics;
heteroatom systems
of particular interest

Cryogenic Solid Stabilization

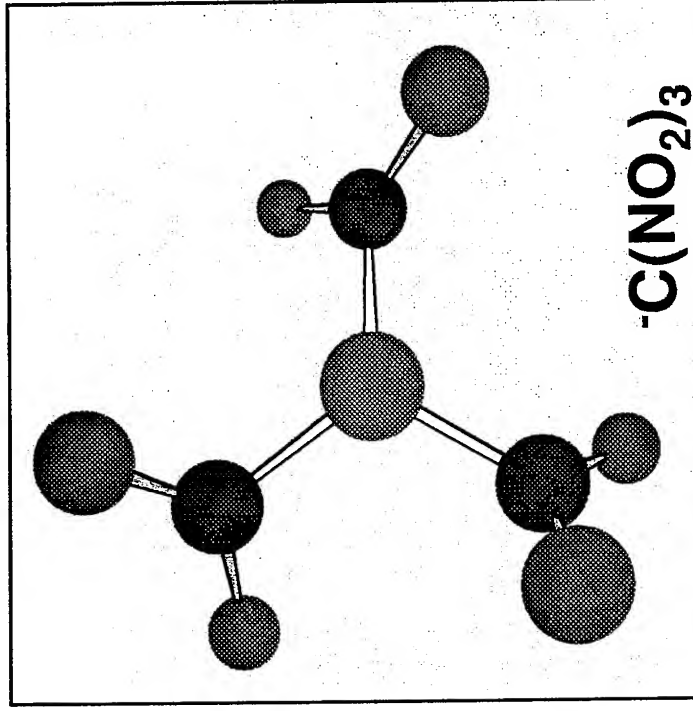
Enables use of highly
energetic systems



Solid Hydrogen Additives

- **Demonstrated trapping of Li, B, N, O, Mg, and Al atoms in solid H₂ at ~ 0.1% concentrations**
- **Samples are stable at liquid helium temperatures**
- **Do not fully understand microscopic structures/dynamics**
- **Need to increase concentrations and sample sizes (recently scaled up from ~ 10 μ m to 1cm H₂ matrices)**

Advanced Monopropellants



<u>Candidate propellants</u>	<u>Isp (sec)*</u>	<u>ρ (g/cc)</u>
- Hydrazine	198	1.00
- Peroxide	164	1.43
- RKS-M1	270	1.69

* P_c=1000 psi, Sea Level exhaust

Approach

- Low melting salts, dissolved in solvents
- Low volatility
- Low toxicity
- Solvents act as fuel, tailor properties
- Low shock sensitivity

Payoff

- Up to 130% Isp*Density Increase
- Double Satellite On-orbit Lifetime
- Non-toxic hydrazine replacement

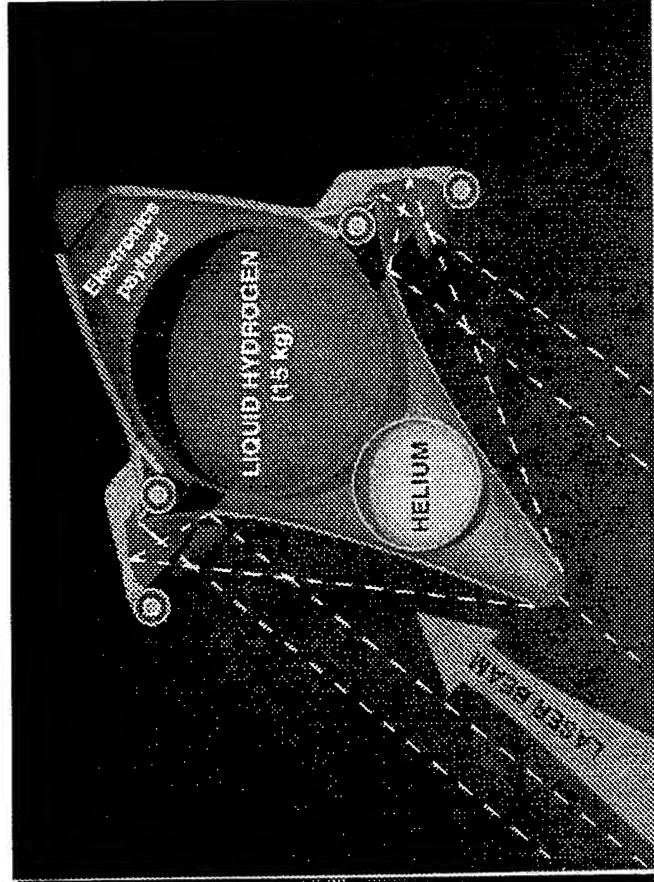
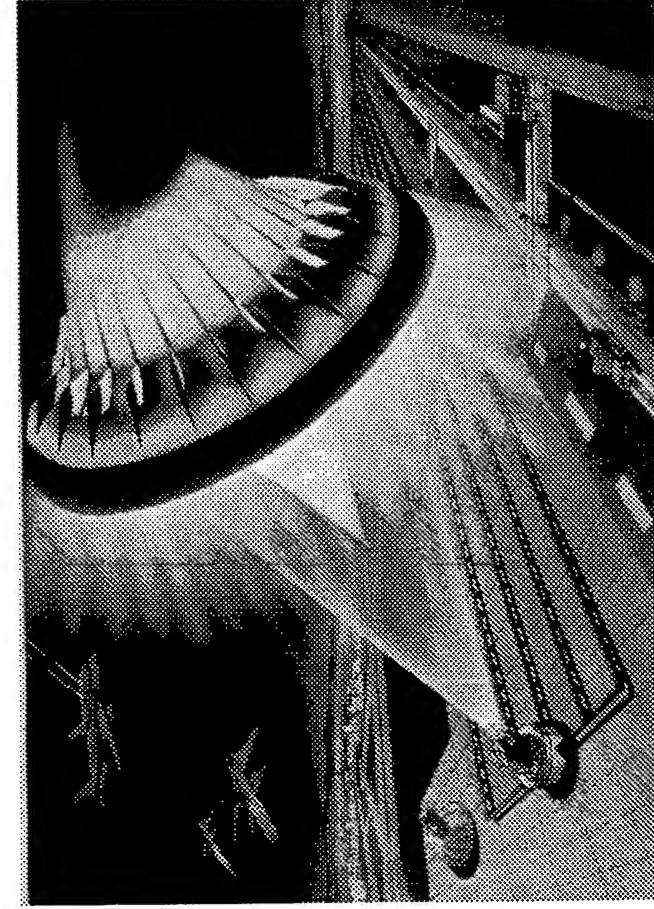
Status

- Several candidates synthesized
- One has low shock sensitivity
- Low cost synthesis established

What is Lightcraft Technology?



Laser Propelled Launch Vehicle

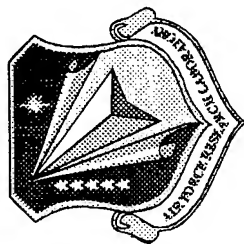


What it will look like:

- Ground-based Laser
- Pulsed Laser Propulsion

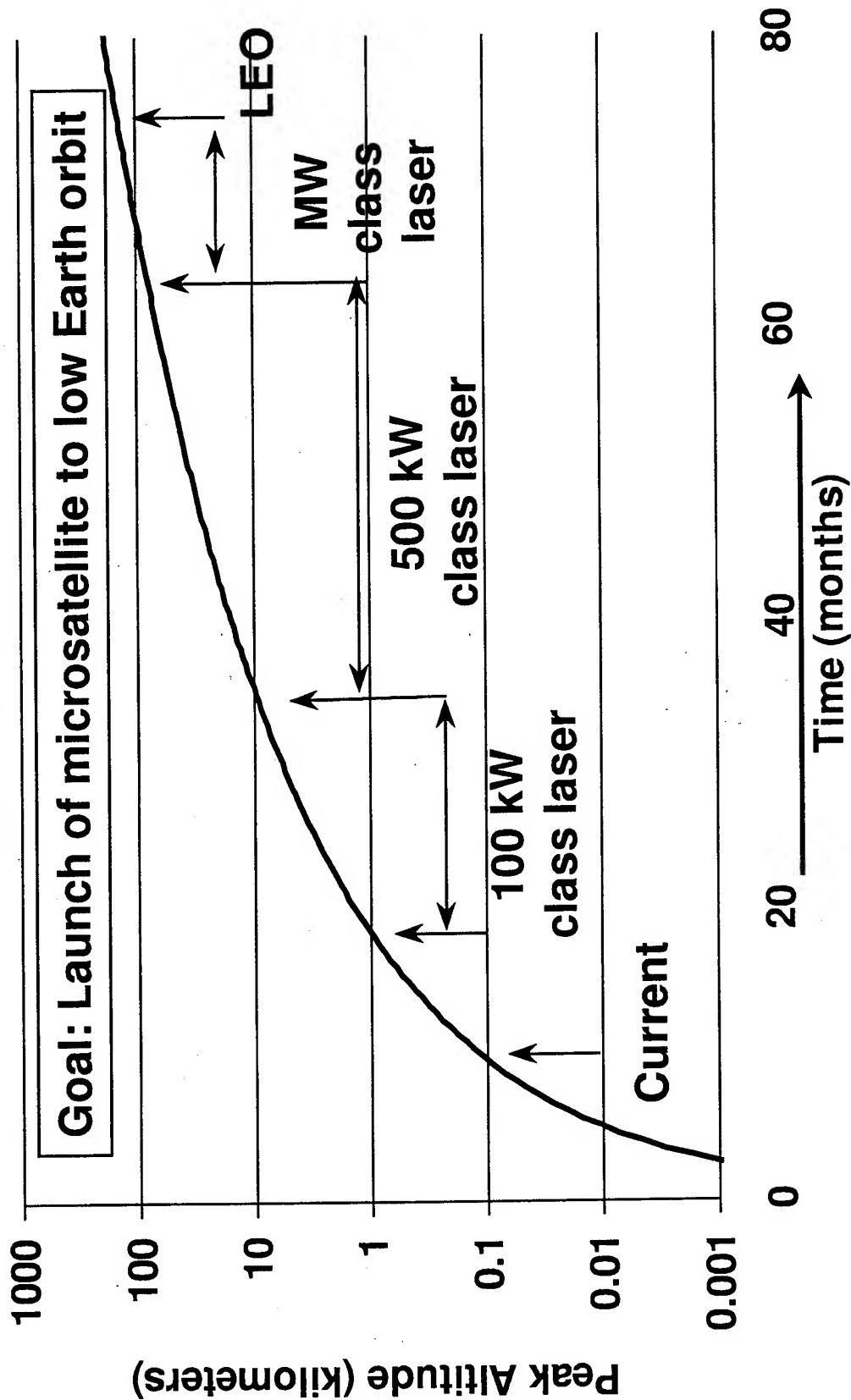
How it will work:

- Air breathing to 30km
- Rocket propelled to orbit

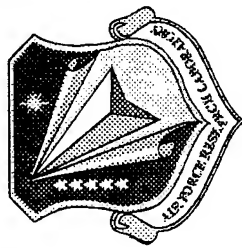


Lightcraft Technology

Schedule



Technology Assessment



Lightcraft Propulsion

Vertical flights, up to 100 miles altitude, air-breathing only	Launch of up to 5 kg into Low Earth Orbit (200 nm)	Launch of up to 100 kg into LEO; interstellar flights
Approximate Milestone Targets		
Near Term (2 - 5 years)	Mid Term (5 - 10 years)	Far Term (20-50 years)
Laser Power Required to Achieve Goal		
100 - 500 kW	2 - 5 MW	100-500 MW